AVIATION SIMULATION TECHNOLOGY INC.

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SIMULATOR

TECHNICAL

DESIGN

FOREWORD

Aviation Simulation Technology manufactures multiengine and single-engine flight simulators for piston powered general aviation aircraft. These simulators may be used throughout the entire flight training spectrum, from initial training for private pilots through instrument and multi-engine rating courses, transition training to complex aircraft and navigation systems, and for recurrency training of private, business and commercial pilots. They are used by flight schools, universities, training institutions, airlines, and even have military applications. The simulator has received U.S. and foreign FAA approval for flight training, airline training, and even for flight checks.

Aviation Simulation Technology flight simulators use high technology microprocessor-based electronics to provide features which have never been previously available except in airline simulators. These features include aerodynamic parameters unavailable from any other manufacturer, the most complete avionics package available, including King Silver Crown equipment and area navigation (RNAV), and plug-in navigation PROMs specifically designed to present all navaids, approaches, and airports in any area of the world. Options include the only 1,000 scale ground track plotter, an instructor console permitting failure of any individual instrument (as well as systems), and a computer-generated visual display showing sky/horizon/ground/runway with selectable ceiling, visibility, and day or night light conditions. The modular design has proven highly reliable in an operational environment, and permits easy testing and replacement by local technicians. It also permits options and new products to be field retrofitted after purchase, allowing growth of the basic unit and addition of new technology as it becomes available.

In the short period since its founding in 1978, Aviation Simulation Technology has dominated the industry, introducing the first microprocessor-based simulator, the first system of real world navigation, the only variable scale plotter, and the first computer-generated visual display. The company has installed more digital computer-based general aviation simulators than all other manufacturers combined, and has the only field service organization with a proven record of domestic and international support. All major U.S. purchasers have selected Aviation Simulation Technology simulators for their use, with one selection occurring after the most comprehensive evaluation yet performed involving all manufacturers.

THE AVIATION SIMULATION TECHNOLOGY,INC. FLIGHT SIMULATOR

The Model 201 single engine and the Model 300 Multiengine flight simulators are digital computer based, full size aircraft panels containing all flight, engine, and navigation instruments and controls required for VFR and IFR operation of an aircraft. The full sized panel gains immediate student acceptance; it looks like a real aircraft. The student equates lessons in the simulator to those in the aircraft, providing a high transfer effectiveness. The flight instructor, always the key to creating the proper learning situation, will adapt immediately to the full sized, realistic cockpit. With appearance, size, and operation designed to be the same as the aircraft, the CFI develops, and communicates to the student, the psychological acceptance needed to facilitate learning. Without this acceptance, simulator use is ineffective, sporadic, and resisted by students and instructors alike.

The electronic section of the flight simulator is comprised of a multifunction power supply, dual processors, converters (for control inputs and instrument and display outputs), and an external navigation storage PROM. The power supply operates on nominal AC line voltages of 100, 117,220, or 234 volts (plus or minus 10%), at 50 to 60 Hz. The specified operating voltage is preset during manufacture, or may be changed by qualified technical personnel. The supply operates well below design capacity, ensuring high reliability and long life.

The navigation microprocessor performs continual calculations of position in three dimensions. It makes all necessary corrections for atmospheric changes, ground proximity, wind, and other factors affecting position. The processor relates the calculated location to the data provided externally through the PROM, and provides signals to the instruments and displays as a function of the calculated position. The accuracy of the position calculation (resolution to under one foot) provides outputs necessary for the visual display, future growth to computer interface (for evaluation, recording, CAI, etc.), or interactive operations with other simulators, thus protecting the investment in years to come.

A second processor performs aerodynamic computations based on pilot settings of pitch, bank, power and configuration. These computations are modified by altitude (air density), ground effect, etc., from the navigation procesor, and are then routed to the displays as performance parameters. Aerodynamic performance is extremely realistic, following curves of lift/drag, airspeed/power, etc. The same effects occur in the simulator as in the airplane, producing a positive transfer. Roll input causes roll; too much will cause overbanking or inverted flight. There are no roll limits to offer an unrealistic protection against overbanking. Inverted flight is truly inverted, with the actual control "reversal" as in flight. The habit of "back is up" produces the same unwanted result as a poor overbanking recovery would in an airplane. However, the simulator student can practice the recovery techniques, experience the early disasters, and learn from the initial mistakes. The "aerobatic" feature permits a full understanding of spatial relationships to be acquired, learning in an environment where "up" is relative.

The outputs of both processors are modified through digital to analog convertors, phase lock loops, etc., to shape the signals for display on standard aircraft instruments, navigation displays, and external connections to the video display and

navigation plotter. The controls and instrument panel functions are similarly converted to phase or digital signals for input to the processor sections. Control outputs are precise and responsive to even small movements. There are no lags or dead spots in the response loop, and the control movements to make ¼ bar width corrections in pitch, or 1 degree changes in roll (and heading) may be taught, and practiced, as in the aircraft. The student does not experience the overcontrol present in other general aviation simulators, which frustrates pilots and destroys acceptance. Instruments are displays, and not part of the integration of control input. An instrument failure will not "ground" the simulator for maintenance. More importantly, individual instruments may be purposely failed from the instructor console as a part of the learning situation. This feature alone can greatly expand the utility and application of the simulator throughout the entire curriculum.

The external navigation PROM is a Programmable Read Only Memory chip in which real-world navigational data has been stored. Data contained in the PROM relates to airports and radio aids to navigation. It includes geographical coordinates, elevation, frequency, morse code identifier, inbound localizer course, and glide slope angle, as applicable. Each PROM contains up to 100 or more data blocks (locations), and provides an "electronic chart" on which the simulator may be flown. The physical size of this chart will vary depending upon the density of the navigational aids within the selected area. Flight may be accomplished entirely within the confines of one PROM, or off the PROM and back on to it. The PROM permits training anywhere, in an exact representation of the area, and with real charts and procedures. Latitude/longitude entry, instead of a grid, permits PROM production to meet any requirement (non-contiguous areas, etc.) with low production cost and short lead time.

With its full size panel to its realistic instruments and avionics to its precise flight dynamics, this simulator has been designed with a purpose. From the start, the student thinks "airplane". The instructor teaches maneuvers in exactly the same manner as in the airplane from takeoff through landing, and reinforces the "think airplane" concept continually. This is the only simulator capable of going well beyond the partial task trainer limits usually encountered. Economic justification becomes obvious; this simulator can be incorporated in more of the curriculum than ever before possible. Furthermore, the total fidelity means faster and more complete transfer effectiveness, reducing training hours, saving money, and producing better pilots.

DETAILED DESCRIPTION

The next page shows the general configuration of a typical multiengine installation; figures A & B show the panel configurations. The following paragraphs provide a detailed description of the function, operation; and limitations of the various components. The 61 components, and their numerous characteristics, all lend to the total realism and make this simulator absolutely unique, and much more useable, than any other unit. Note that all simulator controls are purposely separated from the aircraft section, and are located in the extreme right quarter panel only, in reach of either student or instructor. There is no mixing of functions, and the concept of "think airplane" is preserved throughout.

Aviation Simulation Technology 300 Series Twin Engine Flight Simulator showing installation of Computer Driven Visual System.

AVIATION SIMULATION TECHNOLOGY INC

FIGURE A - SINGLE ENGINE CONFIGURATION

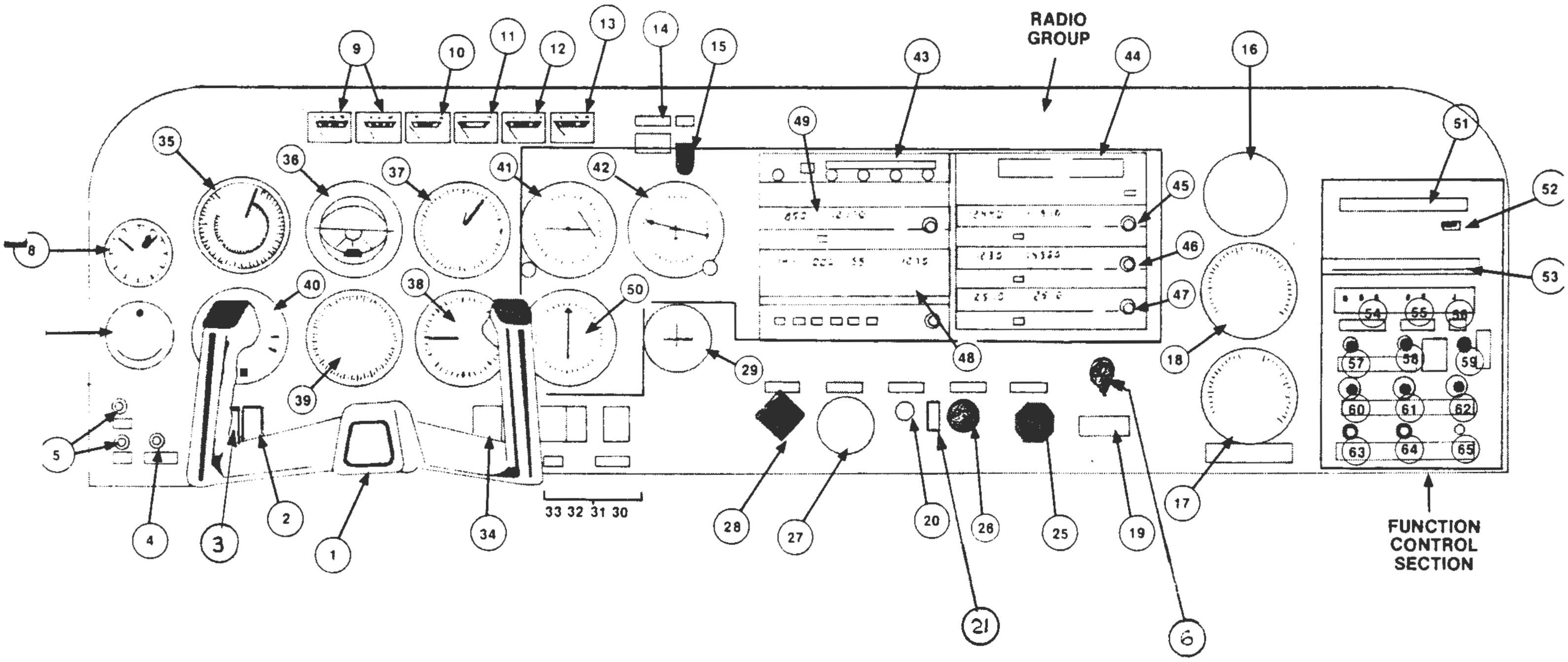
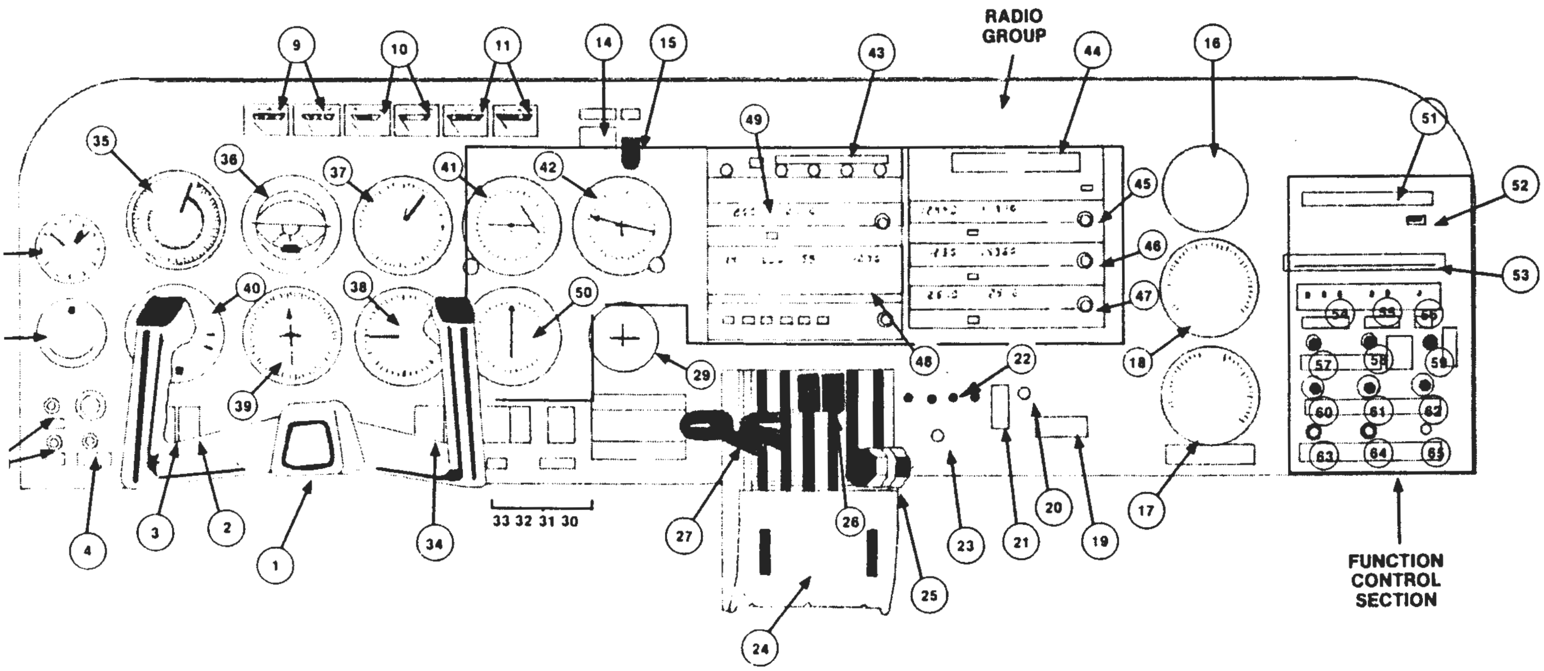


FIGURE B - MULTIENGINE CONFIGURATION



1. CONTROL WHEEL

The control wheel, located at the lower left of the panel, is operated exactly as it is in the aircraft . Control effectiveness changes with airspeed, and trim changes the control wheel position; the pilot trims off control pressures just as in the aircraft. No other simulator incorporates these very important features, needed to reinforce control and trim use.

2. MASTER SWITCH

The master switch is a rocker type switch located at the lower left of the panel, directly beneath the turn coordinator. Setting the switch in the uper position simulates application of battery power to the main bus bar. Setting it in the lower position simulates power cutoff; this may be accomplished on ground or in flight.

3. RADIO MASTER

The radio master switch is located next to the master switch. Setting the switch in the upper position simulates power application to the radio bus bars. Setting the switch in the lower position simulates power removal.

4.& 5. MICROPHONE AND HEADSET JACKS

The panel includes three standard microphone jacks and two standard headset jacks. Two of the microphone jacks and one of the headset jacks are located at the extreme left of the panel beneath the Hobbs meter. One of the microphone jacks accepts a standard aircraft microphone. The other permits installation of a push to talk system. The remaining microphone and headset jacks are located in the environmental section at the extreme right of the panel. These jacks are for the copilot or the instructor, and they provide an intercom capability for added realism and exclusion of outside noise.

6. MAGNETO/STARTER SWITCH (SINGLE ENGINE)

The magneto starter switch has five positions: OFF,R,L,BOTH, and START. In the OFF position, the grounding of both magnetos is simulated. At the R position, the grounding of the left magneto is simulated: the opposite happens in the L position. During mag checks, instrument reaction parallels that of the actual airplane, with RPM dropping off by approximately 75 RPM ($\pm$ 25) and manifold pressure increasing slightly. Turning the switch to START simulates closure of the starter solenoid, starting the "engine". This switch is located on the throttle assembly, near the rudder trim. Thus, engine run up and other ground operations may be introduced and explained in the simulator instead of using fuel in the airplane.

7. HOBBS METER

The Hobbs Meter, located directly below the electric clock, is a conventional elapsed time indicator graduated in hours and tenths of hours. It indicates total time consumed, operating whenever computer power is applied.

8. CLOCK

The electric clock is an aircraft clock with a sweep second hand. It is set by pulling the knkob out and turning it either left or right.

9. FUEL QUANTITY GAUGES

The fuel quantity gauges located in the uppermost section of the panel directly above the attitude indicator, provide an indication of remaining fuel. The fuel system provides approximately 50 minutes of operation per tank at a cruise setting. The gauges can be failed from the instructor console. Fuel use, of course, is a function of power setting, enabling fuel management procedures to be developed.

10. OIL TEMPERATURE GAUGE(S)

The oil temperature gauge, located in the cluster above the flight instruments, simulates the measurement of engine heat, with appropriate time lags for changes to occur. The indication on the gauge may be varied from the instructor console to reinforce instrument scanning procedures or precede the simulation of an emergency. Two oil temperature gauges are incorporated in Multiengine units.

11. OIL PRESSURE GAUGE(S)

The oil pressure gauge, located in the cluster above the flight instruments, simulates a direct reading gauge. The indications on the gauge may be varied from the instructor console. Two oil pressure gauges are incorporated in multiengine units.

12. CYLINDER HEAD TEMPERATURE *

The cylinder head temperature gauge, located in the cluster above the flight instruments, provides simulated temperature readings measured within one of the engine cylinders. The indication on the gauge may be varied from the instructor console.

13. SUCTION GAUGE *

The suction gauge, located in the cluster above the flight instruments, simulates the measurement of the vacuum pressure that is used to operate the gyro instruments. The indication on the gauge may be varied from the instructor console.

14. LANDING GEAR INDICATOR

The gear down position indicator is located on the panel to the left of the gear switch. The indicator illuminates when the lowering of the gear is simulated, after sufficient "in transit" time has elapsed. The indicator may be failed from the instructor console.

* SE units only

15. LANDING GEAR SWITCH

The gear switch, identifiable by its wheel shaped knob, and located on the panel above the ADF, is a two-position switch. Pulling aft and lowering the knob "lowers" the landing gear while pulling aft and raising the knob "raises" the gear. The gear adds drag, affecting performance.

16. SPEAKER

The speaker, located at the right of the panel above the manifold pressure gauge, provides the audio output for the built in cassette tape player and for the radio station signals. Engine noise audio is provided by separately mounted internal speakers.

17. TACHOMETER

The tachometer, located beneath the manifold pressure gauge at the extreme right of the panel, simulates the continuing measurement of engine RPM. Multiengine units utilize dual concentric needles for L and R engines.

18. MANIFOLD PRESSURE GAUGE

The manifold pressure gauge, located above the tachometer toward the right of the panel, simulates the measurement of pressure in the induction air manifold. The gauge is calibrated in inches of mercury (Hg). Manifold pressure will drop, simulating reduced ambient pressure, as altitude is increased. Proper engine operation is thus required even in the simulator, so as not to reinforce negative habits. Multiengine units utilize dual concentric needles for L and R engines.

19. RUDDER TRIM

The rudder trim control is located in the lower right hand segment of the panel next to the mixture control. Rotating the wheel to the right causes yaw to the right. Rotating the wheel to the left causes yaw to the left.

20. FLAP SWITCH

The flap switch, located to the left of the rudder trim, simulates operation of the electrically actuated wing flaps. Holding the spring-loaded switch in the down position lowers the flaps to the desired angle of deflection. Releasing the spring-loaded switch to the OFF position stops the flaps at any intermediate position during either extension or retraction. Pushing the switch to the UP position fully "retracts" the flaps. The flaps add drag and reduce stalling speed when extended.

21. FLAP POSITION INDICATOR

The flap position indicator, located below the right hand radio stack, simulates flap position by movement of a pointer. Markings on the indicator depict the 0 degree, 15 degree and 33 degree (full) flap positions.

22. & 23. MAG SWITCHES AND START LEVER **

The four magneto switches are located to the right of the power quadrant on all twin-engine systems. The start lever is spring loaded to the neutral position and must be held in either the left or right position to start the corresponding engine.

24. POWER QUADRANT **

The power quadrant is a typical twin engine quadrant assembly containing standard levers for throttles, propellers, and mixtures. The function of each lever is the same as that described for its counterpart in the single engine series. The propeller controls also contain a detent for the "feather" position.

25. MIXTURE CONTROL

The mixture control simulates the adjustment of the fuel-air ratio of the engine. Pushing the control forward simulates a richer mixture and pulling it back simulates a leaner mixture. There is no apparent effect on engine operation or instrument indications. Pulling it all the way back to idle cutoff shuts down the engine.

26. PROPELLER CONTROL

The propeller control simulates the changing of propeller pitch, and consequently, engine RPM. Pushing the control forward increases RPM; pulling the control back decreases it.

27. THROTTLE

The throttle is located at the left of the propeller control. Pushing the throttle forward simulates an increase in manifold pressure and a consequent increase in engine power. Pulling the throttle back simulates a decrease in manifold pressure and a reduction in engine power. Power may also be varied from the instructor console, simulating fluctuations or engine loss.

28. CARBURETOR HEAT *

The carburetor heat control is located to the left of the throttle. Pulling the control aft simulates routing of heated air to the carburetor and a corresponding drop in MP. Pushing it forward simulates use of normal, filtered air.

29. COMPASS

The compass simulates a flat face compass, with its inherent compass turning and acceleration errors. Compass errors, limitations, and even compass turns may be taught in the simulator.

** ME units only

* SE units only

30. FUEL SELECT SWITCH

The switch, located to the left of the engine controls, is a rocker type switch used to simulate the switching of fuel tanks. When the switch is set in the upper position, the left tank is selected. In the lower position, the right tank is selected. Fuel use is cumulative. Switching back to a tank which has been partially depleted will provide only the fuel quantity previously remaining.

31. PARKING BRAKE

The parking brake is a white rocker type switch located next to the fuel select switch on the lower protion of the panel. When the switch is set in the upper position, the brake is engaged. When the switch is set in the lower position, the brake is released. This is the only active brake system on the fight simulator. It is used to stop motion on taxi or landing and to prevent motion on engine start and runup. It must be released for taxi or takeoff; however, it has no effect during flight.

32. PITOT HEAT SWITCH

The pitot heat switch is located to the left of the handbrake. Setting the switch in the upper position simulates the application of heat to the pitot system. Setting the switch in the lower position removes it. Switch activation does not affect operation or instrument indication, but may be used procedurally when pitot icing is simulated or anticipated.

33. BOOST PUMP SWITCH

The Boost Pump switch is located to the left of the Pitot Heat Switch and behind the control wheel. The switch simulates operation of the electric fuel boost pump(s). There is no apparent effect on operation or instrument indication, but procedural use may be introduced and practiced.

34. ELEVATOR TRIM

The Elevator Trim control is located below the VSI, next to the Pitot Heat Switch. Rotating the trim forward simulates the lowering of the nose; rotating it aft simulates raising the nose. This unique trim relieves control pressure on the control wheel, teaching the student to trim the simulator exactly as in the airplane, and avoiding the "fly with trim" habit often developed as students learn a simulator.

35. AIRSPEED INDICATOR

The Airspeed Indicator is marked in knots, and contains all required limitation markings and color coding. The indicator may be failed from the instructor console.

36. ATTITUDE INDICATOR

The Attitude Indicator gives a visual indication of flight attitude. Bank attitude is represented by a pointer at the top of the indicator relative to the bank scale. Pitch attitude is represented by an airplane silhouette in relation to the horizon. A knob at the bottom of the instrument is provided for adjustment. Pitch stops limit pitch indications to $\pm$ 20 degrees; roll movement is unlimited, and inverted flight is properly displayed. Pitch and/or bank may be failed from the instructor console. The background moves for both pitch and bank motion, exactly as in the aircraft.

37. ALTIMETER

Altitude is depicted by a simulated barometric type altimeter. The barometric setting can be adjusted with the knob at the lower left of the instrument. The altitude display limit of the instrument and the simulator is 9500 ft. Altitude indications may be failed from the instructor console.

38. VERTICAL SPEED INDICATOR

The vertical speed indicator depicts airplane rate of climb or descent in feet per minute. The pointer is actuated by simulated atmospheric pressure change with appropriate lags typical of this type of indicator. The VSI may be failed from the instructor console.

39. HEADING INDICATOR or HSI

The heading indicator (directional gyro) displays heading on a compass card in relation to a fixed airplane image and an index graduated in degrees. The card is adjusted with the knob at the lower left edge of the instrument. The indicator may be failed from the instructor console. Accuracy and movement are so precise as to permit heading changes of less than one degree to be made; a necessity for instrument training.

In HSI equipped units, a King 525A HSI, with slaved gyro, is provided.

40. TURN COORDINATOR

The Turn Coordinator, located at the lower left of the flight instrument cluster, displays rate of turn via the positioning of a miniature aircraft silhouette display. Index marks depict standard rate turns of 3 degrees per second. The ball instrument displays damped skid/slip forces.

41. KI 209 VOR/LOC/GS INDICATOR (NAV 1)

The KI 209, located to the left of the ADF Indiactor, operated in conjunction with the KNS-80 INTEGRATED RNAV to simulate operation of a VOR/LOC left-right needle, to-from indicator, glideslope deviation needle, and the NAV warning and glideslope warning flags. The OBS knob is rotated to position the azimuth card to the desired heading. The CDI may be failed from the instructor console. In HSI equipped units, the HSI will display VOR/L0C/GS indications, or these may be displayed as described on NAV 1. Selection is accomplished through a rear mounted selector switch, allowing training on either type of system.

42. ADF INDICATOR

The ADF indicator displays the bearing of the station relative to the nose of the aircraft when the rotatable card is aligned with zero against the nose index. When the rotatable card is set to correspond to the aircraft's magnetic heading, magnetic bearing is read directly under the head of the pointer. Reciprocal bearing is read under the tail of the pointer. The indicator may be failed from the instructor console.

43. KT 76A TRANSPONDER

The KT 76A located at the top of the left-hand radio stack, simulates the radar beacon equipment. The transponder contains a five position function selector switch, four eight position code selector switches, and an IDENT momentary push button. Operation of the transponder is procedural only, and has no effect on the displays or operation of the flight simulator.

44. KMA 20 AUDIO MIXER and MARKER BEACON RECEIVER PANEL

The KMA 20 is located at the top of the right side of the radio stack. The panel simulates the functions of the marker beacon receiver, the isolation amplifier and the audio control panel.

45. KY 196 VHF/COMM TRANSCEIVER (COM 2)

The KY 196 panel, located in the middle of the left-hand radio stack, permits simulation of two way voice communication within the frequency range of 118.000 MHA to 135.975 MHZ in 25 KHZ increments.

46. KN53 NAVIGATION RECEIVER (NAV 2)

The KN53 is a panel mounted 200 channel VHF VOR/LOC receiver, located in the middle of the right hand radio stack. The receiver provides VOR/LOC information to the associated CDI display.

47. ADF RECEIVER

The digital ADF receiver, located at the bottom of the right-hand radio stack, provides LF radio reception. The bearing information is displayed on the ADF indicator.

48. KNS 80 INTEGRATED NAVIGATION SYSTEM (NAV 1)

The KNS 80 displays and radio heads, located in the left hand radio stack, provide a complete simulation of a 200 channel VOR/LOCALIZER receiver, a 40 channel glideslope receiver, a 200 channel DME and a digital RNAV computer with the capability for preselection and storage of 4 VORTAC frequencies and RNAV waypoint parameters.

49. KY 196 VH/COMM TRANSCEIVER (COM 1)

The KY 196 panel, located in the middle of the left hand radio stack, permits simulation of two way voice communication within the frequency range of 118.000 MHZ to 135.975 MHZ in 25 KHZ increments.

50. KI 208 VOR/LOC-OBS INDICATOR (NAV 2)

The KI 208, located directly below the KI 209 indicator, operates in conjunction with the KN 53 Navigation Receiver, to simulate operation of the VOR/LOC left right needle, to from indicator, and the VOR/LOC and NAV warning flags. The OBS knob is rotated to position the azimuth card to the desired heading. The CDI may be failed from the instructor console.

51. CASSETTE PLAYER

The casette player assembly, which may be used with any audio cassette tape, is located at the top of the control section.

52. CASSETTE CONTROL

The silver lever, located just below the tape receptacle, is used for FAST FORWARD, REWIND, and EJECT.

53. PROM RECEPTACLE

The PROM receptacle is mounted with the access opening located directly below the cassette player. The PROM's may be changed by the operator with the same ease as changing a cassette.

54. WIND DIRECTION

Wind direction control consists of a set of three digital ten position selector switches located directly below the PROM receptacle. The wind direction is set by selecting any true direction from 0 to 360. Wind may be changed at any time during the flight; a wind shear selection will cause it to change automatically with altitude change. The wind direction may be encoded, so as not to be readily discerned by the student, by setting multiples of 360, up to 999, in the selector switches.

55. WIND VELOCITY

Wind Velocity control consists of a set of two ten position digital selector switches located next to the WIND DIRECTION switches. The desired wind velocity, in kts., is set in by selecting the desired number from 0 to 99. Velocity may be changed at any time furing a flight; a wind shear selection will cause velocity to change as a function of altitude.

56. FLT STABILITY

The Flight Stability switch is a single, ten position digital selector switch located next to the WIND VELOCITY switches. The switch is used to set in ten levels of random turbulence and wind shear ranging from light to severe; 0 is OFF.

57. FLIGHT HOLD

The FLIGHT HOLD switch is a pushbutton switch located directly below the WIND DIRECTION switches. The switch is pressed to "freeze" the simulator in flight dynamics, navigation, and instrument displays, for purpose of evaluation, critique, or discussion.

58. CASSETTE VOL

The CASSETTE VOL control is a rheostat located next to the FLIGHT HOLD button.

59. SELECT SWITCH

The SELECT switch is a rotary selector switch used as part of the initialization process, the inflight repositioning mode, and refueling. It permits instant relocation to any navaid, waypoint, airport, or stored position (location and altitude) at any time, inflight or on the ground. Thus, enroute flight may be eliminated, multiple approaches flown, positions memorized, or any segment of a lesson repeated as necessary.

60. CASSETTE HOLD

The CASSETTE HOLD button, located below the wind velocity switches is used to stop and restart the tape player.

61. ENGINE VOLUME

The ENGINE VOL knob is a rheostat which is used to raise or lower engine sound.

62. ACTIVATE BUTTON

The ACTIVATE button is used in conjunction with the various navigation instruments to establish a desired point of departure. It is also used to set up the inflight repositioning mode, as described in Select Switch 59.

63. MICROPHONE

The MICROPHONE jack, located next to the PHONE jack, accepts a standard microphone plug.

64. PHONE

The PHONE jack, located below the CASSETTE HOLD button, accepts a standard headset plug.

65. COMPUTER POWER KEY

The COMPUTER POWER KEY is a two position switch used to apply power to or remove it from the entire flight simulator.

Aviation Simulation Technology Automatic Plotter with Digital Setup. Capability to plot on any chart with a scale of .1 to 99.9 nautical miles per inch.

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Aviation Simulation Technology 300 Series Instructor Console with provisions for failing or altering 18 different instruments or systems.

AVIATION SIMULATION TECHNOLOGY INC

SINGLE ENGINE CONVERSION KITS

The single engine conversion kit will permit a multiengine flight simulator to be configured to a single engine unit when appropriate for the training requirements. The conversion requires approximately one hour to accomplish, and can be readily reversed in the same amount of time. No soldering, special tools, or recalibration of the simulator is necessary.

The conversion kit consists of a single engine throttle quadrant assembly with magneto switches and starter, an engine gauge group, a manifold pressure gauge, and an RPM gauge. The simulator, when converted, will have all of the characteristics inherent in the Aviation Simulation Technology single engine simulators. This permits a much greater economy of invested funds and classroon space, and maintains commonality of units.

GROUND TRACK PLOTTER

The plotter is a programmable pen and ink recorder that is used to provide a graphic duplication of any flight pattern or course on any chart (WAC, sectional, local, low altitude enroute) or blank paper. The plotter is capable of operation in any scale, ranging from 0.1 N.M. per inch to 99.9 N.M. per inch. The plot can also be centered about any navaid or airport at the selected scale, permitting a graphic depiction of any portion of the PROM's geographical area. The expanded modes permit a more precise investigation of flight performance during specific maneuvers (e.g. holding patterns, rectangular courses, wind drift circles, etc.), permit vectoring, and provide a permanent record of student performance. The plotter's portability permits it to be incorporated in or excluded from the student's view, or from the lesson itself.

Plotter controls consist of a set of digital switches mounted at the upper left hand section of the front panel, and a function selector switch on the right. The switches are used to set in a station frequency, as part of the plotter centering function, and to select the scale factor for the plot. The function selector is used to load, center the chart, and automatically plot courses. The sequence to be followed during initial operational setup consists of selecting the desired scale to be used, centering the appropriate radio station in accordance with the location of the desired plot, and loading the machine. Once these functions are performed, plotter operation becomes fully automatic... i.e., power is turned on automatically and the plotter continues to function uninterrupted until the flight is over. Charts, center positions, and scale factors may be changed at any time during a flight without stopping the simulator or affecting its performance.

INSTRUCTOR CONSOLE

The instructor console contains control and switching circuits that are used to induce engine and instrument failures individually or in any desired combination. The panel is divided into two basic sections, the top housing the PWR ON and ENGINE FAILURES controls in a single row and the bottom, a double row of INSTRUMENT FAILURES buttons. The console is designed to be used remotely for greater teaching effectiveness.

From an instructional point of view, the purpose of the console is to permit the remote failure of simulator instruments in any combination. Combinations may be devised to represent specific malfunction symptoms, such as failure of Airspeed, Altimeter, and VSI indicators to represent Pitot Static System failure or icing. Based upon observation of the pilot's actions, failures may then be eliminated when the proper corrrective action is taken. In the example, Altimeter and VSI operation may be returned when use of the Alternate Static Source is indicated, and Airspeed returned when Pitot Heat is applied.

INSTRUCTOR CONSOLE FUNCTIONS ARE AS FOLLOWS:

SWITCH/KNOB	TYPE	FUNCTION
PWR ON	PUSHBUTTON	Engages failure modes. Visual controls are independent of PWR switch.
ENGINE POWER	RHEOSTAT	Simulates power loss or engine failure. Rotate counter clockwise to gradually lower manifold pressure.
CYL TEMP (SE)	RHEOSTAT	Controls cylinder head temperature indication.
OIL PRES	RHEOSTAT	Controls oil pressure indication.
OIL TEMP	RHEOSTAT	Controls oil temperature indication.
SUCTION (SE)	RHEOSTAT	Controls gyro suction pressure indication.
ASI	PUSHBUTTON	Fails airspeed indicator to zero.
AI PITCH	PUSHBUTTON	Fails attitude indicator in the pitch axis.
AI BANK	PUSHBUTTON	Fails attitude indicator in the bank axis.
VSI	PUSHBUTTON	Fails vertical speed indicator.
HI	PUSHBUTTON	Fails heading indicator at present heading.
ALT	PUSHBUTTON	Fails altimeter at present reading.
GEAR	PUSHBUTTON	Fails gear indicator.
NAV 1	PUSHBUTTON	Fails NAV 1 CDI and G/S to center.
NAV 2	PUSHBUTTON	Fails NAV 2 CDI to center.
ADF	PUSHBUTTON	Fails ADF indicator indicator.
FUEL GAUGES	PUSHBUTTON	Fails fuel gauges to present reading.

VISUAL DISPLAY CONTDROL FUNCTIONS

CEILING	DIGITAL SWITCHES	Selects height AGL at which the VFR to IFR transition occurs.
VISIBILITY	RHEOSTAT	Controls contrast approximating visibility changes.
DAY/NIGHT	RHEOSTAT	Gradually changes scene from high contrast day to all black night.
RNWY LIGHTS	RHEOSTAT	Controls intensity of runway edge light.

VISUAL DISPLAY

COMPUTER GENERATED IMAGERY (CGI)

The overall objective of the visual display is to present the proper visual cues to permit instruction in and reinforcement of many maneuvers in primary, instrument, and multiengine training which utilize visual cues. The visual display adds a new dimension to simulator operation. Instruction in VFR maneuvers is now possible; as is teaching and practicing of visual reference and combined scan techniques. Instrument to visual transition can now be taught prior to actual IFR flight, allowing the more common mistakes to be experienced in a controlled environment. Pilots can experience decision making situations during an approach when the ceiling is set at or just below decision height, forcing them to make their own decision to continue or execute a missed approach. The visual display also adds the the positive psychological effect of providing visual reinforcement for instrument flight; an approach can be flown to a landing, a runway appears where it should be (not necessarily where the student hopes it will be), and an obvious evaluation of technique is available (and indisputable).

The visual display is a computer generated image of horizon, sky, ground, and runway, with provisions for restriction to visibility and ceiling. Presented on a CRT (Cathode Ray Tube), the display represents the visual scene as observed through the pilot's windshield. In VFR conditions, the pilot will see a scene similar to a horizon with runway and runway lights if an airport is within view. As the runway is approached, the orientation of the runway becomes apparent and visual alignment for landing or overflight may be accomplished. During landing, the runway grows proportionally larger, filling more of the display and eventually disappearing off the edge of the screen as the runway lights go by on rollout or fly by.

The exact scene presented is a function of the aircraft location with respect to stored (PROM) data, altitude, attitude, and the ceiling and visibility as set on the visual controls. For each airport, the latitude, longitude, and altitude of the airport reference point (ARP) are stored in the PROM. Airport scenes consist of a runway two miles long with the mid point of the runway over the airport reference point. (Since the end of the runway is always computed as one mile from the airport reference point, slight differences from actual position are possible, but these are not detectable on the visual display). Only one runway of one airport is shown at any one time.

For flight into visual conditions, the ceiling and visibility may be set to the desired values on the Instructor Console. At altitudes above the ceiling, the visual display scene is that of in-cloud conditions. As descent is made below the ceiling, breakout into visual conditions will occur. Decreased visibility setting reduces the contrast of the runway environment, eliminating images of the runways or objects beyond the established visibility (the horizon will not be affected). While in flight, airports (runways) can be made to disappear into the "haze".

U.S. Department
of Transportation

**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

Feb. 25, 1981

Mr. Edward L. Keins
Director of Sales
Aviation Simulation Technology Inc.
Hanscom Field - East
Bedford, Massachusetts 01730

Dear Mr. Keins:

The Aviation Simulation Technology Model 300 instrument ground trainer, manufactured and sold by your company, contains sufficient features that may permit it to be used for the permissible instrument ground trainer time under Part 141.41, provided that the ground trainer is used with an enclosed pilot's station or cockpit which will accommodate one or more flight crewmembers.

The ground trainer may be used in training the pilot in "controlling and maneuvering an airplane solely by reference to instruments, including descents and climbs using radio or radar directive." However, Part 61 of the regulations provides that an applicant for a private pilot's certificate must have at least 40 hours of flight time, all of which must be in an airplane. Ground trainer time cannot be credited toward this total time requirement.

Under Part 61, an applicant for a commercial pilot's certificate must have at least 250 hours of flight time as a pilot which may include 50 hours of instruction from an authorized instructor in an instrument ground trainer. The Aviation Simulation Technology Model 300 instrument ground trainer will be acceptable to the Administrator for this purpose(s).

Under Part 61, an applicant for an instrument rating must have at least 40 hours of instrument flight time which may include 20 hours of instrument instruction by an authorized instrument instructor (ground or flight) in an instrument ground trainer. Again, the Aviation Simulation Technology Model 300 instrument ground trainer may be used for this time.

The Aviation Simulation Technology Model 300 instrument ground trainer may also be used in connection with maintaining instrument currency under Section 61.57(e); that is, it may be used for three of the required 6 hours of instrument time as well as performing the required six instrument approaches.

Transport Canada Transports Canada

Air Air

Ottawa, Ontario
K1A 0N8

Your file Votre référence

October 9, 1981

Our file Notre référence
5802-23-4 (LICP/L)

Mr. Edward L. Keins
Director of Sales
Aviation Simulation Technology Inc.
Hanscom Field - East
Bedford, Massachusetts 01730
U.S.A.

Dear Sir:

An evaluation was conducted upon the Aviation Simulation Technology (AST) Model 300 twin engine instrument ground trainer by Civil Aviation Inspectors from this Headquarters.

Approval was granted for the use of the AST Model 300 as an instrument ground trainer for the crediting of instrument ground time, as specified in Transport Canada (Air) Personnel Licensing Handbook Volume I, Flight Crew, for the following licences, endorsements and ratings.

(a) the issue of a flight crew licence;
(b) a night endorsement; and
(c) the instrument rating.

Should you have any further questions, please contact this Headquarters or the appropriate Regional Offices.

Yours truly,

L.J. Barrett
for Chief
Aeronautical Licensing Division
Aeronautical Licensing and Inspection Branch
Civil Aeronautics